

AN EXPLORATION OF FACILITY LOCATION METRICS IN INTERNATIONAL SUPPLY CHAIN

Abstract

Purpose - Companies could gain competitive advantage through the supply chain network. Especially facility location represent possible source of cost and service performance improvement. The goal of this article is to explore and expose what could be the facility location key performance indicators.

Design/methodology/approach - A literature review is conducted to examine research relating to supply chain network distribution performance measurement, facility location and KPIs on global and local level.

Findings - An exploration of the supply chain performance literature reveals global and local KPIs that could be used for the facility location measurement. A list of key performance metrics related to facility location is presented.

Keywords – Glocal strategy, Distribution network design, Facility location, Supply chain performance measurement, KPIs.

Introduction

Due to global economy, volatile markets, competitive pressure, the rising cost of energy and carbon emissions, new technologies, more rigorous quality and quicker response requirements: the survival of many companies depends on the ability to continuously improve quality while reducing costs. Strengthening global competitiveness is still the top priority for companies in all sectors. Excellent supply chain management can make a considerable contribution to achieving this, through supply chain network configuration. The latter is a key strategic factor for increasing organizational effectiveness and for better realization of organizational goals such as enhanced competitiveness, better customer care and increased profitability. Important competitive advantages can be obtained through consolidation and regionalisation of the supply chain network (AT Kearney, 2009).

As new forces and dynamics are emerging, future supply chain networks processes have to respond to these continuous changes. The issue of globalisation will continue to have an absolutely central role to play in supply chain management in the future (AT Kearney, 2009). Equally apparent has been the move towards global sourcing and manufacturing as companies concentrate their operations on few factories that serve the whole world. Pipelines are longer with greater reliance on outsourced supply chain partners. Increase in logistics (especially oil prices), risks and labor cost in developing countries and the volatility of commodity are affecting supply chain design. As local differences in requirements still exist, the needs of local markets must be balanced against the economic advantage of standardized products. The emergence of customer-driven markets has resulted in rapid changes to strategies adopted by organizations. Therefore, the whole question of supply chain network design will be more central to overall organization competitiveness than it has been. There will be more sensible, hybrid approaches to supply chain management that combine regional and global activities (Simchi-Levi and Fine, 2010).

Ideally organizations would like to achieve the benefits of standardization in terms of cost reduction whilst maximizing their marketing success through localization (Christopher, 2005). Consequently, in response to globalization, the ever increasing customer demands for variety and rapid delivery at acceptable costs, companies search for innovative supply chain network configuration especially for locating activities. Thus, the challenge of facilities location is to structure a supply chain that balance between global efficiency and local responsiveness that best supports the company's competitive strategy and maximize competitive advantage. It is especially the case for facilities location relating to the distribution network as it delivers the local markets. Moreover, according to Gunasekaran, 2001, perhaps the most important research concerning logistics that is going on is in the area of designing efficient and cost-effective distribution systems. Facility location decisions are among the most important supply chain decisions, as their implications are significant and long lasting. Therefore, in order to evolve an efficient and effective supply chain, most companies realize that supply chain networks need to be assessed for their performance. As facility location decisions are very important for the supply chain's performance and supply chain related KPIs have not been widely adopted and businesses are typically uninformed of them (Bongsug, 2009), the facility location performance measurement will be focus on KPIs.

Consequently, in this context, how is it possible to link facility location with KPIs performance measurement?

The purpose of this study is to understand the link between facility distribution location and global and local supply chain performance with key performance indicators. How should management select a set of facility locations in such a way as to minimize costs (inventory and transportation) and satisfy service level requirements? Because of the multi-disciplinary nature of the supply chain performance management topic, the paper is located at the intersection of supply chain network with facility distribution location, supply chain performance measurement topics and KPIs.

The structure of the article is as follows: first, we will present the link between facility location and performance, then, in a second part we will explore and present the possible metrics for facility location performance measurement.

I – THE LINK BETWEEN FACILITY LOCATION AND PERFORMANCE

I-1 THE CONCEPT OF SUPPLY CHAIN MANAGEMENT PERFORMANCE

The objective of supply chain management is to be efficient and cost-effective across the entire system; total systemwide costs, from transportation and distribution to inventories of raw material, work in process, and finished goods, are to be minimized. Thus, the emphasis is not on simply minimizing transportation cost or reducing inventories but, rather on systems approach to supply chain management. Finally, the supply chain management encompasses the firm's activities at many levels, from the strategic level through the tactical to the operational level. Therefore the goals are to design and operate a supply chain so that the total systemwide costs are minimized, and the systemwide service levels are maintained. Thus, the supply chain performance affects the ability to provide customer value, especially in the most basic dimension of availability of products (Simchi-Levi, 2008).

In the past the focus of many companies was primarily on efficiency, i.e, a continuing search for lower costs, better use of capacity, reduced inventories. These are still worthy goals today but the priority has shifted. Now the emphasis must be on effectiveness. The challenge is to create strategies and procedures that will enable organizations to become the supplier of choice and to sustain that position through higher levels of customer responsiveness (Christopher, 2005).

The era of both globalization of markets and outsourcing has begun, and many companies select supply chain to manage their operations and to assess the performance (Gunasekaran, 2001). Globalization of markets and operations has given new perspectives of various managerial functions that include the different value chain. These new managerial perspectives require new tools in terms of suitable performance measures and metrics (Gunasekaran and Kobu, 2007).

I-2 ACHIEVING STRATEGIC FIT FROM STRATEGY TO FACILITY LOCATION

For any company to be successful, its supply chain strategy and competitive strategy must fit together. Strategic fit means that both the competitive and supply chain strategies have aligned goals. It refers to consistency between the customer priorities that the competitive strategy hopes to satisfy and the supply chain capabilities that the supply chain strategy aims to build. All processes and functions that are part of a company's value chain contribute to its success or failure. The design of the overall supply chain and the role of each stage must be aligned to support the supply chain strategy (Chopra and Meindl, 2010). That's the reason why the supply network design must be aligned to the supply chain strategy.

Consequently, achieving strategic fit from strategy to facility location improves supply chain performance.

I-3 GLOCAL STRATEGY AND PERFORMANCE

"A global strategy seeks to maximize worldwide performance through sharing and integration..." (Yip, 1992, p.31). Whilst the global strategy may be implemented, the product may need certain customization to meet specific country needs (Christopher, 2005). A worldwide strategy has to adapt to local conditions, characteristics and circumstances. The introduction of the "glocal strategy" and "glocalization" concepts may be a compromise to

improve the present usage of the term global strategy: the glocal strategy approach reflects the aspirations of a global strategy approach, while the necessity for local adaptations of business activities is simultaneously acknowledged (Andersson & Svensson, 2009, p.31). Therefore, the “glocal strategy” concept is introduced to provide an improved accuracy of the present usage of a global strategy approach. It comprises local, international, multinational and global strategy approaches. It differs from the global strategy approach in that it explicitly recognizes the importance of local adaptations, differences and synchronization in the marketplace of business activities. The concept thus contributes to the balance and harmony of locally and globally related issues and includes a spectrum of local, domestic, international and multinational and global strategies. Glocalization means that the standardization and adaption of companies’ business activities are optimized. Nevertheless, it is a matter of thinking globally and acting locally, i.e acting and thinking “glocally” (Andersson & Svensson, 2009). There is a continuum from the local adaptations of worldwide strategies on one side, and the universal or global strategies without adaptations on the other that could improve the company’s overall performance.

I-4 SUPPLY CHAIN STRATEGY AND PERFORMANCE

“Supply chain is a group of partners who collectively convert a basic commodity (upstream) into a finished product (downstream) that is valued by end-customers, and who manage returns at each stage...Logistic strategy is the set of guiding principles, driving forces and ingrained attitudes that help to coordinate goals, plans and policies, and which are reinforced through conscious and subconscious behaviour within and between partners across a network” (Harrison and van Hoek, 2011, p.7). A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customers themselves. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving a filling a customer request. These functions include but are not limited to, new product development, marketing, operations, distribution, finance, and customer service (Chopra and Meindl, 2010).

A typical supply chain may involve a variety of stages. These supply chain stages include: Customers, Retailers, Wholesalers/distributors, Manufacturers, Component/raw material suppliers...

A supply chain strategy determines the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operation to provide the service, and distribution of the product to customer...(Chopra and Meindl, 2010). Aligning markets requirements with supply chain capabilities through SCS creates a competitive advantage (Hoffmann, 2010). Consequently, the primary purpose of any supply chain is to satisfy customer needs and, in the process, generate profit for itself. The objective of every supply chain should be to maximize the overall value generated. The value (also known as supply chain surplus) a supply chain generates is the difference between what the final product is worth to the customer and the costs the supply chain incurs in filling the customer’s request. For any supply chain, there is only one source of revenue: the customer. Each decision should be made to raise the supply chain surplus. Supply chain decisions have a large impact on the success or failure of each firm because they significantly influence both the revenue generated and the cost incurred (Chopra and Meindl, 2010).

A supply chain is dynamic and successful supply chain requires many decisions relating the flow of information, products and funds (Chopra and Meindl, 2010). One of these decisions is supply chain design. During this phase a company decides how to structure the supply chain over the next several years. It decides what's the supply chain configuration will be, how resources will be allocated, and what processes each stage will perform. A firm must ensure that the supply chain configuration supports its strategic objectives and increases the supply chain surplus during this phase.

Therefore, the goal of supply chain strategy is to strike the balance between responsiveness and efficiency that fits with the competitive strategy. To reach this goal, a company must structure the right combination of the three logistical drivers (facilities, inventory and transportation) and three cross-functional drivers (information, sourcing and pricing). For each of the individual drivers, supply chain managers must make a trade-off between efficiency and responsiveness based on interaction with the other drivers. The combined impact of these drivers then determines the responsiveness and the profits of the entire supply chain (Chopra and Meindl, 2010). Therefore, to understand how a company can improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical drivers like facilities, inventory and transportation drivers.

Moreover, the globalization of supply chains involves dimensions such as offshoring of production, inventories, suppliers and customers, and differences in economies, infrastructures, cultures and politics in the competitive environment (Christopher, 2005). Globalization may increase revenue generation through entry to new markets and may provide access to suppliers that can provide materials and inputs more efficiently than domestic sources. As companies have extended their supply chains internationally they have been forced to confront the issue of how to structure their global logistics organization. The effects of globalization, technology and the growing need for environmental responsibility and sustainability is forcing organizations and individuals to make changes in the way they live, work and play (Gopal *et al.*, 2012). Rapidly changing global economic environment, green concepts and social responsibility pressures from governments shows the significant need to raise critical questions such as: do organizations need different set of measures for both responsive and efficient supply chains? Hence, it is critical to develop an efficient supply chain performance measurement system. However, monitoring and improvement of performance of a supply chain has become an increasingly complex task (Cai *et al.* 2009). Effectiveness in global logistics can only be achieved through a greater element of centralization. Certain tasks and functions lend themselves to central control and others to local management. By their nature, decisions on location in a global network can only be taken centrally (Christopher, 2005). As supply chains are international, the supply chain management performance must adapt to this new context and develop metrics global and local. The on-time product delivery becomes more complex and challenging than ever. Global KPI allow standards development and best practices in performance measurement and companies. But companies need to adopt and adjust them to their specific environments (Cai *et al.*, 2009).

I-5 SUPPLY CHAIN NETWORK PERFORMANCE IN THE SUPPLY CHAIN

According to the link between strategy and supply chain strategy, changing the strategies impact supply chain strategies and network design.

Definition

The physical supply chain consists of suppliers, plants, warehouses, distribution centers, and retail outlets as well as raw materials, work-in-process inventory, and finished products that flow between the facilities (Simchi-Levy, 2008).

Supply chain network design decisions determine the physical configuration and infrastructure of the supply chain. It includes the assignment of facility role, location of manufacturing, storage, or transportation-related facilities, and the allocation of capacity and markets to each facility. Therefore supply chain network design decisions are classified as follows: facility role, facility location, capacity allocation, market and supply allocation (Chopra and Meindl, 2010).

Network design is a strategic decision that has a long-lasting effect on the firm because it involves decisions relating to plan and warehouse location as well as sourcing and distribution (Simchi-Levy, 2008).

Distribution refers to the steps taken to move and store a product from the supplier stage to a customer stage in the supply chain. Distribution is a key driver of the overall profitability of a firm because it affects both the supply chain cost and the customer experience directly. The appropriate distribution network can be used to achieve a variety of supply chain objectives ranging from low cost to high responsiveness.

Strategy

Based on the competitive strategy of the firm, its resulting supply chain strategy must determine the supply chain design for the firm. The supply chain strategy specifies what capabilities the supply chain network must have to support the competitive strategy. A firm must ensure that the supply chain configuration supports its strategic objectives and increases the supply chain surplus this phase (Chopra and Meindl, 2010).

Supply chain network design and performance

Network design decisions regarding the *role, location, capacity, and flexibility* of facilities have a significant impact on performance because they determine the supply chain configuration and set constraints within which the other supply chain drivers can be used either to decrease supply chain cost or to increase responsiveness.

The goal when designing a supply chain network is to maximize the firm's profits while satisfying customer needs in terms of demand and responsiveness. The network is designed to maximize total profits taking into account the expected margin and demand in each market, various logistics and facility costs, and the taxes and tariffs at each location. Then, in designing any supply chain, one of the key considerations is to know what costs are incurred, where they are incurred, and how they be managed. We need to understand where cost can be minimised and where value can be maximised (Chopra and Meindl, 2010). The objective is to design or reconfigure the logistics network in order to minimize annual system wide cost,

including production and purchasing costs, inventory holding costs, facility costs (storage, handling, and fixed costs), and transportation costs, subject to a variety of service level requirements (Simchi-Levi, 2008).

For example, a poor distribution can hurt the level of service that customers receive while increasing the cost. An inappropriate network can have a significant negative effect on the profitability of the firm, as evident in the failure of many business-to-consumers. The appropriate choice of distribution network results in customer needs being satisfied at the lowest possible cost (Chopra and Meindl, 2010). Consequently, a manager must consider the customer needs to be met and the cost of meeting these needs when designing the distribution network. A network designer needs to consider the strategic position, the product characteristics as well as network requirements when deciding on the appropriate distribution network (Chopra and Meindl, 2010).

Moreover, the implementation of global pipeline is highly dependent upon the ability of the organization to find the correct balance between central control and local management (Christopher, 2005).

I-6 FACILITIES LOCATION PERFORMANCE IN THE SUPPLY CHAIN NETWORK

Decisions regarding facilities location are a crucial part of supply chain design (Chopra and Meindl, 2010). Location decisions are closely intertwined with capacity sizing, timing and type decisions: together, they constitute a resource portfolio or network strategy.

Definition

Facilities are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated. The facilities are the *where* of the supply chain. They are the locations to or from which the inventory is transported. Within a facility, inventory is either transformed into another state (manufacturing) or it is stored (warehousing) (Chopra and Meindl, 2010). The two types of facilities are production sites and storage sites. In this paper, we focus on the distribution facilities, the storage sites.

Strategy

Location is the geographical positioning of an operation. Deciding where a company will locate its facilities constitutes a large part of the design of a supply chain. Firm's regarding its choice of location of its warehouse are all supply chain design or strategic decisions. These decisions have a long-term impact lasting several years. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years. Companies must consider a host of issues related to the various characteristics of the local area in which the facility is situated. These include macroeconomics factors, quality of workers, cost of workers, cost of facility, availability of infrastructure, proximity to customers, the location of that firm's other facilities, tax effects and other strategic factors (Chopra and Meindl, 2010).

A location strategy is a structured approach to deciding where to expand or contract capacity. It starts by reviewing the competitive strategy: what is the value proposition to customers and shareholders. Then, the location decision must be aligned with the competitive strategy by comparing the priority rankings of competencies that location should provide, i.e, what is the relative importance of cost, quality, flexibility, and responsiveness. This ranking guides how the various factors should be weighted in making the location decision. The factors can be

categorized as mainly affecting assets (resource capacity) or activities (processes) (Van Mieghem, 2001).

Facility location and performance

One of the most important strategic decisions in the supply chain network made by many companies is where to locate their operations (Van Mieghem, 2001). Indeed, facility location decisions have a long-term impact on a supply chain's performance, on the overall risk and profit of the company because it is very expensive to shut down a facility or move it to a different location. The cost of moving an operation from one site to another can be hugely expensive and the risks of inconveniencing customers very high. Then, it can be an important decision because it usually has an effect on an operation's cost as well as its ability to serve its customers (and therefore its revenues). So getting location wrong can have a significant impact on profits. When locating facilities, revenues come from the sale of products, whereas costs arise from facilities, labor, transportation, material and inventories (Chopra and Meindl, 2010). Christopher (2005) specifies that location decisions are a basic determinant of profitability in international logistics. The decision on where to manufacture, to assemble, to store, to tranship and to consolidate can make the difference between profit and loss. Because of international differences in basic factor costs and because of exchange rate movements, location decisions are fundamental. Also these decisions tend to involve investment in fixed assets in the form of facilities and equipment. Decisions taken today can therefore have a continuing impact over time on the company's financial and competitive position.

Facilities locations are the key driver of supply chain performance in terms of responsiveness and efficiency. Thus, a manager's goal when locating facilities and allocating capacity should be to maximize the overall profitability of the resulting supply chain network while providing customers with the appropriate responsiveness. A good location decision can help a supply chain be responsive while keeping its costs low. In contrast, a poorly located facility makes it very difficult for a supply chain to perform close the efficient frontier (Chopra and Meindl, 2010).

A manager must consider many trade-offs during network design and facility location. A basic trade-off here is whether to centralize in order to gain economies of scales or to decentralize to become more responsive by being closer to the customer. Companies can gain economies of scale when a product is manufactured or stored in only one location. This centralization increases efficiency. The cost reduction, however, comes at the expense of responsiveness, as many of a company's customers may be located far from the production facility. The opposite is also true. Locating facilities close to customers increases the number of facilities needed and consequently reduces efficiency. If the customer demands and is willing to pay for the responsiveness that having numerous facilities adds, however, then this facilities decision helps meet the company's competitive strategy goals (Chopra and Meindl, 2010). Thus, a company striving for responsiveness could have many warehousing facilities located close to customers even though this practice reduces efficiency. Alternatively, a high-efficiency company would have fewer warehouses to increase efficiency despite the fact that this practice will reduce responsiveness.

Facility location strategy may be driven by a combination of cost and speed delivery. In essence, the firm must balance the costs of opening new warehouses with the advantages of being close to the customer. Thus, warehouse location decisions are crucial determinants of whether the supply chain is an efficient channel for the distribution of products (Simchi-Levi, 2008).

Moreover, according to international supply chains, when changing from localization, practitioners should know about what measures they should use? How to analyze the performance of supply chain warehouse location evolution by using suitable measures? The reason of this complexity is performance measures differ from context to context (Gopal et al., 2012)

II– PERFORMANCE MEASUREMENT AND LOCATION FACILITIES

The subject of performance measurement is encountering increasing interest. This, for the most part, is due to the broadening spectrum of performances required by the present-day competitive environment (De Toni and Tonchia, 2001). There are several reasons for measuring performance: for improving performance, for avoiding inconveniences before it's too late, for monitoring customer relations, for process and cost control and for maintaining quality (Ackerman, 2003). From a system perspective, feedback is necessary for every system or organism's survival. Performance measurement or monitoring plays the role of feedback in one's supply chain (Bongsug, 2009).

II-1 DEFINITION PERFORMANCE MEASUREMENT

Performance measurement system is an important issue in the development of organisations. Two widely known axioms are (Boyett and Conn, 1993): “What you measure is what you get” and “if you can't measure it, you can't manage it because you won't know if it improves”. Things for which we can devise indicators can be managed; things for which we have no indicators can be out of control before we realise it. Performance measurement spans many disciplines and it is a broad topic.

From the performance measurement literature, the two categories of “efficiency” and “effectiveness” are frequently addressed as the main indicators of a company's performance. According to Neely *et al.* (1995), effectiveness refers to the extent to which a function meets its goals and efficiency is a measure of how the firm's resources are utilised. Hence, the level of performance business attains is a function of the efficiency and effectiveness of the actions it undertakes. A performance measurement system, therefore, can be defined as set of metrics used to quantify both the efficiency and effectiveness of actions. It can be concluded therefore that performance measures are established to achieve goals and are provided with the intent to monitor, guide and improve all the business functions as a whole

Neely *et al.* (1995) defined it as the process of quantifying the efficiency and effectiveness of an action or activity. The purpose of performance measurement is to find out whether things are going the right way and, if not, to find what are the causes that generate a poor performance.

II-2 PERFORMANCE MEASURES

Performance measures and metrics are essential for effectively managing logistics operations, particularly in a competitive global economy. The global economy is featured with global operations, outsourcing and supply chain (Gunasekaran and Kobu, 2007).

Performance measure refers to an indicator used by management to measure, report, and to improve performance (financials, growth, customer focus, business processes, environment community...). These are classed as either a Key Result Indicator (tell what you have done in

a perspective), a Performance Indicator (tell what you do), or a Key Performance Indicator (tell what you do to increase performance dramatically) (Parmenter, 2007).

KPI represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization (daily/weekly basis) (D.Parmenter, 2007). The idea of “Key Performance Indicators” (KPIs) suggests that, whilst there are many measure of performance that can be deployed in an organization, there are relatively small number of critical dimensions that contribute more than proportionately to success or failure in the marketplace (Christopher, 2005). These KPIs derive from the strategic goals themselves and can used for benchmarking supply chain performance (Parmenter, 2007). The KPIs reveal the gap between plan and execution and offer opportunities to identify and correct potential problems (Chopra and Meindl, 2010).

These KPIs can be hierarchically organized. There are several possible approaches. One way is to hierarchically group KPIs as top tier, mid-level and ground level. For easy and fast implementation, Bongsug (2009) recommends two layers: primary and secondary. The primary metrics represent a company’s overall supply chain performance, which should be regularly monitored by the top management and the middle management responsible for demand and supply management. The secondary metrics are potentials indicators of why the primary metrics are high and low and offer a detailed view of supply chain.

Moreover, global standards should be implemented to measure and benchmark the performance of supply chains on a global and local basis (A.T Kearney, 2009, p.20). The goal is to provide more holistic measures that allow managers to understand synergies available or to make appropriate trade-off decisions. A measurement approach across the supply chain is important because decisions can have important implications for global and local performance. Global KPI could be implemented on the supply chain strategic level and local KPI could be implemented on the supply chain operational level.

Potential KPIs should focus on only a small list of KPIs which are critical for their operations management, customer service, and financial viability. Developing key metrics becomes a daunting task, considering that listing potential supply chain related KPIs itself appears to be inexhaustible. Choosing the right number of key KPIs is a challenge to many companies In supply chain performance measurement “less is better”: companies should start with a small number of KPIs which are absolutely necessary to monitor the meta-level processes (plan, source, make and delivery) which can they can successfully manage and operate (Bongsug, 2009).

II-3 SUPPLY CHAIN PERFORMANCE MEASUREMENT

Definition

Supply chain performance measurement or monitoring is the term for a set of metrics and processes related to assessing and evaluating how accurate the planning is and how well the execution is carried out (Bongsug, 2009).

The need for performance measurement

Performance measures and metrics are needed to achieve a fully integrated supply chain.

Coordination of the supply chain has become strategically important as logistics evolve (Goknur and Turan, 2010) with the importance of strategic alliances, global outsourcing, shorter product life cycles, partnership formation and collaboration, agility responsiveness, flexibility, reverse logistics and extended enterprise integration (Gunasekaran, 2004). Moreover, such measures and metrics are needed to test and reveal the viability of strategies without which a clear direction for improvement and realization of goals would be highly difficult. Customer value, product characteristics, channels to market, cost reduction – all those considerations combine to require different kinds of supply chains (Simchi-Levi and Fine, 2010). “When you think about customer value in general, it’s multidimensional. Customers could find value in price, in quality, in selection, in branding. No company can be successful on all dimensions. Wal-Mart says it’s going to compete on price, and so the supply chain is supporting it is focused on cost. That’s not the case for a company like Amazon. The customer value proposition value that Amazon provides is a set of choices. They are focusing on responsiveness. They’re focusing on service level and customer service...The supply chain that needs to support this type of customer value is different than the supply chains that need to support an every day low-pricing strategy” (Simchi-Levi, 2008) You cannot dominate on all the dimensions. What is your objective? Is it cost or service?

There is a greater need to study the measures and metrics in the context of the following two reasons:

- A lack of balanced approach. Many companies have realized the importance of financial and non-financial performance measures. However, they failed to understand them in a balanced framework.
- A lack of clear distinction between metrics at strategic, tactical and operational levels. (Gunasekaran, 2001).

Gunasekaran and Kobu (2007) mention the following as the purposes of a performance measurement system:

- identifying success,
- identifying if customer needs are met,
- better understanding of processes,
- identifying bottlenecks, waste, problems and improvement opportunities,
- providing factual decisions,
- enabling progress,
- tracking progress,
- facilitating a more open and transparent communication and co-operation

II-4 SUPPLY CHAIN PERFORMANCE FRAMEWORKS

The measurements should be derived from the company’s strategy and include all key processes and outputs as the results of the processes. Performance management is the process by which the company manages its performance in line with its corporate and functional strategies (Goknur and Turan, 2010).

Frameworks for performance measurement systems (PMS) have been developed for supply chain management.

One particular framework, the Supply Chain Operations References, the SCOR model created by SCC (Supply Chain Council) in 1997 gained growing use and increased visibility,

contributing to the development and evolution of supply chain performance measurement systems and maturity models by providing a standardised way of viewing the supply chain, offering a consistent scorecard framework for development of performance, emphasising process orientation and deemphasising functional orientation, enabling cross-industry benchmarks.

The model becomes useful as it comes to develop supply chain metrics. According to the model, a company's supply chain would be represented by four meta-level processes: plan, source, production, and delivery. For example, the metrics for the process deliver are: *On time shipment*, *On time delivery*, *Perfect Order fulfilment*, *In-stock availability*.

In practice, this high-level view of SCM processes can be useful for identifying potential Key Performance Indicators. Potential KPIs should be developed for each of the supply chain operations-reference (SCOR) model's four meta-processes (plan, source, make, and delivery) and need to be hierarchically grouped such as primary and secondary metrics (Bongsug, 2009).

According to De Toni and Tonchia (2001), the goal is pursuing the performance results on different levels. The performance measures of the operations can be conceptually divided into two and the research has shown that there are four distinct performance dimensions and so types of indicators: cost/productivity, time, flexibility, quality:

The traditional cost performance (the production cost and the productivity) are kept separate from the innovative non-cost measures (quality, time and flexibility). The first dimension is that of cost (performances of the economic-financial type or directly linked to them):

- cost performances, including the production costs (separated into materials and labour) and the productivity. The cost performances are distinguished for having a direct link with the final results of the firm, that is net income and profitability. The cost performance indicators have traditional measures, such as the cheapness of the production costs, the productivity, the control of the working capital.

The other three instead are non-cost in nature (performances of a physical type, even though influencing the economic-financial performances):

- non-cost performances, regarding the time, flexibility and quality.

The non-cost performances are generally measured by non-monetary units of measure, and as far as, they influence the economic and financial performances (net income and profitability), the link with them cannot be calculated "a priori" in a precise manner as for the cost performances.

The time is a performance dimension that regards both internal times (that is those the firm controls but the customer does not see directly) and external times (those that concern the customer, in other words, delivery time and frequency of introducing new products).

Externally-perceived time performance are split into: system times (including supplying, manufacturing and distribution lead times), delivery speed and delivery reliability (from both suppliers and to customers), time to market (or time required to develop a new product).

Flexibility is, in theory, a performance apart since it is an ability to change something in relation to all three performances of cost, time and quality. There are various types of flexibility (volume, mix, product, process, expansion).

There are four types of quality measured (produced quality, perceived quality, in-bound (supply) quality; and quality costs).

Therefore the consideration of the value, in addition to the traditional financial performances (measured by ROI, discounted cash flow...), determines a marked customer orientation, considering a long-run period in which to analyse the satisfaction and fidelity to the customer (De Toni and Tonchia, 2001).

In the framework presented by Gunasekaran (2001) for measuring the performance of a supply chain, the metrics are distinguished as financial and non financial and classified at strategic, tactical and operational levels. For effective management in a supply chain, measurement goals must consider the overall supply chain objectives and the metrics to be used.

Gunasekaran *et al.* (2004) develop a framework for supply chain performance measurement based on four main decision areas of SCOR model (plan, source, make, deliver) and it provides a detailed measurement and metrics classification and uses a survey aiming at assessing importance within each metric group. This model presents high performance metrics (KPI) that target broader functional areas of supply chain.

According to Gunasekaran *et al.* (2004), Gunasekaran and Kobu (2007), the new era performance measurement metrics should be based on company strategy and objectives, reflected a balance between financial and non financial measures, related to strategic, tactical and operational levels of decision making and control...

Bongsug (2009) proposes a list of metrics which are essential for a firm's operations management, customer service and financial viability.

The supply chains of tomorrow must deliver varying degrees of six outcomes – the traditional cost related benefit plus responsiveness, security, sustainability, resilience and innovation depending on key customers' needs. The new supply chain is strategically couples and value driven (Melnik *et al.* 2010).

II-5 SUPPLY CHAIN DISTRIBUTION NETWORK PERFORMANCE

The goal is to identify performance measures that need to be considered when designing the distribution network. At the highest level, performance of a distribution network should be evaluated along two dimensions: customer needs that are met and cost of meeting customer needs (Chopra and Meindl, 2010). Thus, a firm must evaluate the impact on customer service and cost as it compares different distribution network options. Although customer service consists of many components, we focus on those measures that are influenced by the structure of the distribution network. Some key customer needs to be considered include response time, product variety/availability, convenience, order visibility and returnability. Important costs that managers must consider include inventories, transportation, facilities and handling, and information.

Firms that target customers who can tolerate a long response time require only a few locations that may be far from the customer (Simchi-Levy, 2008). Order lead time refers to the time which elapses between the receipt of the customer's order and the delivery of the goods. An important challenge faced by many organizations is how much should they centralize (or decentralize) their distribution system. What is the impact of each strategy on inventory levels and transportation costs? What about the impact on service levels?

II-6 FACILITY LOCATION METRICS

As mentioned before, location facilities decisions are fundamental (Christopher, 2005). When changing from localization, practitioners should know about what measures they should use? How to analyze the performance of supply chain warehouse location evolution by using suitable measures? In the era of globalization it is critical to select the right choice of performance metrics and measures. The reason of this complexity is performance measures differ from context to context (Gopal *et al.*, 2012).

A manager should track the following facility-related metrics that influence supply chain performance (Chopra and Meindl, 2010).

- Location of supply sources and markets
- Location of potential facility sites
- Demand forecast by market
- Facility, labor, and material cost by site
- Transportation costs between each pair of sites
- Inventory costs by site and as a function of quantity
- Sales price of product in different regions
- Taxes and tariffs
- Desired response time and other service factors.

The location metrics could be characterised by their ability to pursue several performances at the same time. There is a logic of “trade off” between performances (De Toni and Tonchia, 2001). The goal is pursuing the performance results on different levels. According to AT Kearney (2009), logistics costs (three cost components: transport costs, warehousing costs and inventory costs) are one of the most important key metrics for supply chain performance. Moreover, these measures must be aligned with customer satisfactions. Key customer requirements regarding a company’s supply chain entail product availability and competitive lead time followed by delivery reliability. “On-time” delivery is more important than a complete delivery “in full”. Excellent service quality in supply chain management can significantly contribute to a company’s success on the market. Requirements concerning delivery lead time vary by industry. Even though delivery reliability has reached a high level with 93 percent over time, a gap still exists between customer expectations of 98.8 percent reliability and the suppliers’ actual performance. Today, customers take it for granted that each single delivery must be accurate and undamaged. Quality of service takes place during service delivery, which is the interaction between the customer and the service process.

In the following table, we try to summarize the different KPI from the literature review that could be related to facility distribution location metrics:

Proposed location facility KPIs

KPI	Cost	Service
	<i>Production cost :</i> -Inventory costs (L) -Transport costs (L) -Facilities/warehouses costs (L) -Handling (L) -Information (L) <i>Productivity :</i> -Labor productivity (L) -Capital productivity (L)	<i>Time :</i> -Delivery Lead time (G) -Response time (G) -On time shipment (G) -On time delivery (G) <i>Flexibility :</i> -Product variety/variability (G) -Order visibility and returnability (G) -In stock availability (G) - Frequency of delivery (L) <i>Quality :</i> -Delivery Reliability (L) -Perfect order fulfilment (G) -Delivery “in Full” (G) -Quality of service (L)

Source: author according to the framework on metrics developed by Gunasekaran (2001).

G: Global L: Local

A further research could bring more highlights in this first classification, especially for strategic and operational KPIs.

CONCLUSION

An attempt has been made to present the link between facility location and performance and the possible metrics for facility location performance measurement. Facilities locations are important decisions and impact the performance of the companies. Consequently, it is important to explore the supply chain performance frameworks that could highlight the metrics that could be used in order to measure location facilities especially the location distribution facilities. Moreover, in an international supply chain, performance measurement can be analyzed according to different levels global and local. This is due to glocal strategies that are implemented in order to realize a compromise between global and local scale. Then, the challenges are to succeed the classification of the different facility location metrics according to different criteria existing in international supply chains. It is critical according to the impact on the overall performance of the business.

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